EMO PROJECT NO. 79

EVALUATION OF ASPHALT CRACK SEALING IN DAMP CONDITIONS

INTERIM REPORT NO. 1

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ABSTRACT

Investigation in EMO Project No. 33 "Evaluation of Crack Sealing Materials for Asphaltic Pavements" concluded that, unless cracks are completely dry and clean at the time of routing and sealing, bond failure of the sealant within the routed groove can be expected the first winter.

Since dry crack conditions seldom exist, a suitable method of sealing cracks under damp conditions must be identified. This project was developed to verify the feasibility of using hot compressed air, in combination with various methods of crack preparation, to seal cracks in which moisture is present.

This first interim report covers the construction of eighteen test sections in June 1982, on the Ottawa Queensway, in which six different methods of crack preparation were performed in triplicate under damp conditions. Three different sealants which had demonstrated superior performance in EMO Project No. 33 were used. Also reported is a December 1982 appraisal of the trial sections which revealed satisfactory performance to date.

A subsequent interim report on the performance of the trials will be prepared at the end of 1983 to be followed by a final report in 1984.

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BACKGROUND

In the continuing evaluation of materials for sealing cracks in asphalt pavement (EMO Project No. 33), much has been learned about the performance of sealants in general, namely:

1. Dampness in cracks when routed and sealed, almost guarantees a bond failure the first winter,

2. During winter, the primary cause of failure is bond,

3. Seals installed by overfilling the routed crack and striking off the sealant so as to create a diaphragm bonded to the pavement surface on each side of the routed groove, survive better than seals poured flush in the groove.

Routing and sealing should not be performed when the pavement cracks are damp, because the moisture retains the cutting dust and forms a slurry like paste on the freshly routed surfaces which will not be removed by air cleaning. This slurry then prevents the hot poured sealant from making an intimate bond with the pavement, resulting in a bond failure. Restricting routing and sealing operations to days when the pavement cracks are dry, severely limits the number of days in a year that crack sealing may be performed with the present operational methods.

During the material trials, the Ministry was introduced to a device called a hot compressed air (HCA) lance which is used in Europe to clean and heat pavement cracks prior to a sealant being poured and levelled over them (overband sealing). This HCA lance combines propane ignition with compressed air to produce a jet of hot gasses up to 1100^{o}C at a pressure of 690 kPa.

A project was proposed to evaluate the use of HCA in combination with various methods of crack preparation which would permit crack sealing to proceed in damp conditions.

PROJECT DESIGN

The trials were designed to couple HCA and the most commonly promoted methods of crack preparation and variations of those methods. Six methods of crack preparation were selected to be installed in triplicate using three of the most promising materials identified in EMO Project No. 33.

The method of crack preparation prior to being treated with HCA is contained in Table 1.

TABLE 1

Method of crack preparation prior to HCA

1	Rout 19 mm wide and deep
2	Rout 13 mm wide and deep
3	Rout 19 mm wide and deep and flush clean with water
4	Rout 13 mm wide and deep and flush clean with water
5	Wet diamond saw 13 mm wide and deep and flush clean with water
6	Crack left untreated

After the crack preparation and not necessarily on the same day, the crack was to be dried, blown clean and heated with HCA immediately ahead of placing the hot sealant. The HCA should slightly etch out the matrix of the pavement on the surface, for a width of 40 mm each side of the prepared crack.

The six methods would be performed in triplicate using:

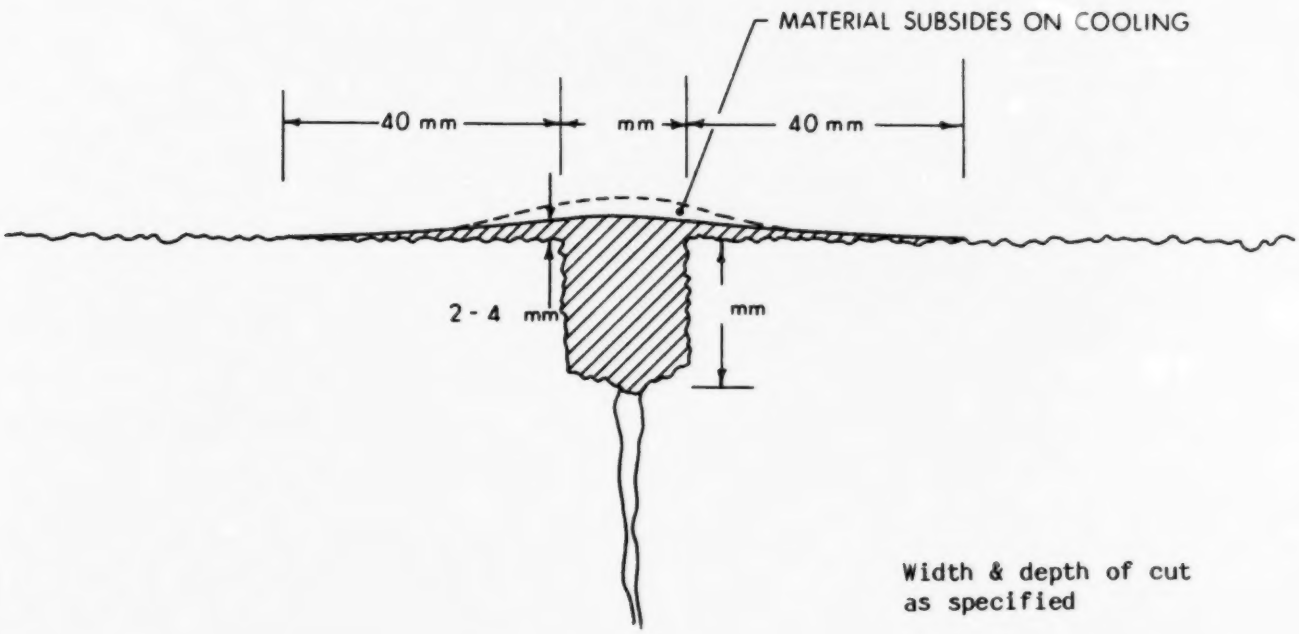
1. Cariphalte ELT - Shell Canada Ltd.,

2. Supergook - Bemac Industries Ltd.,

3. Hi-Spec - W.R. Meadows Canada Ltd.

The hot sealant would be installed according to the cross-section in Figure No. 1. The bead of sealant over the prepared crack is to provide a cross-sectional thickness at the edges of the crack to minimize the splitting which most often occurs at this point.

FIGURE 1



Desired Cross Section of Sealed Crack

Ottawa District was chosen for the trials because it has:

(a) a severe environment for crack sealing performance (Jan. mean min. daily temp. - 15.6°C and three expected occurrences of -30°C per winter),

(b) quality routers capable of following meandering cracks,

(c) a compressor rather than back pack blowers for cleaning out routed grooves,

(d) a melter capable of pumping the sealant via a hose and wand to the prepared crack,

(e) conscientious personnel experienced in crack sealing.

The fact that the Ottawa crack sealing crew already use a compressor in their routine work, allows for the easy incorporation of the hot compressed air lance. The only addition to the equipment compliment, other than the lance itself, would be a source of propane.

In order to duplicate conditions similar to that occurring after an overnight rain, the pavement would be wetted down prior to commencement of the crack sealing activities each day.

LOCATION

A portion of the Ottawa Queensway, a four lane divided highway, (Hwy. 417) between Richmond Rd. and Eagleson Rd. was chosen for the trial area. This section of highway carries about 39,000 vehicles per day with a high percentage of commuters between the bedroom community of Kanata and Ottawa. For this reason lane closure on the highway is not permitted before 9:00 a.m. and traffic control is required to be removed by 3:30 p.m., severely restricting working time.

This section of highway had been crack sealed four years previously and now new cracks required sealing. Since the older sealed cracks were routed and sealed by pouring flush, the new crack sealing with the overband seal will be easily distinguishable in future evaluations. Each

section was selected to contain approximately 500 m of crack and the beginning of each section marked with a steel post and small number plate at the edge of shoulder in the median. See Figure 3. The individual sections may also be located according to the key map in Figure 2 and distances provided in Table II. A summary of installations and individual installation notes for each section are contained in Appendix I.

FIGURE 2

KEY MAP

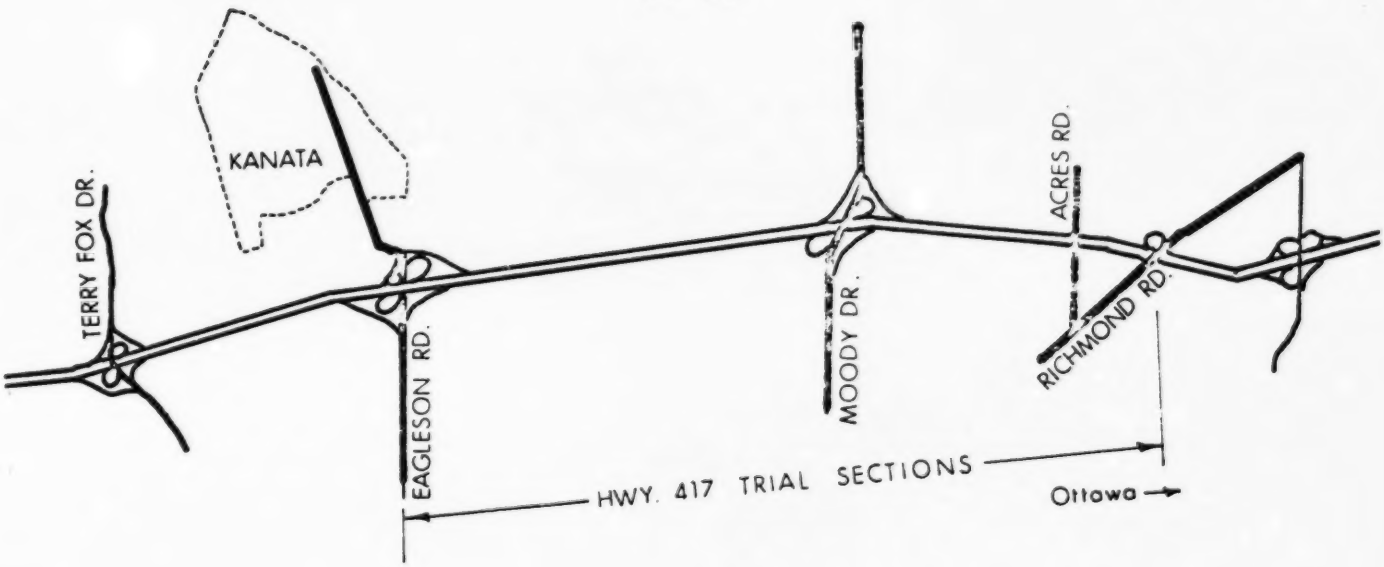


FIGURE 3

Marker Post with Number Plate

TABLE II

TEST SECTION LOCATIONS

SECTION NO.	km.	417 WESTBOUND
1	0.0	Richmond Rd. Overpass
2	0.8	
3	2.1	
4	3.1	
5	4.1	
6	5.0	
7	5.6	
8	6.0	
9	6.3	
10		Exit Ramp Eagleson Rd.
	km.	417 EASTBOUND
11	0.0	Eagleson Rd. Overpass
12	0.5	
13	0.9	
14	1.9	
15	2.7	
16	3.5	
17	4.5	
18	5.3	

EQUIPMENT

- Routers (2), Crafco, Model 200
- Diamond Saw (1), Easy-Cut Runway Crack Cutter, Model WCE-1200
- Melter (1), Crafco, Model BC 220
- H.C.A. Lance (1), Bemac, Model B-1

A two ton truck with a stake body, was equipped with a 170 CFM compressor in the back along with a rack of five 45 kg liquid propane bottles headed together. The HCA lance mixing unit was then coupled to the compressor and propane tanks and the 42,000 V ignition system for the lance wired into the truck electrical system. This truck was also used to haul the melter, providing a very compact working unit. See Figure 4.

A five ton truck equipped with a 4,550 L water tank and pump was used to wet down the pavement and to flush out the specified cut cracks.

Various other vehicles and equipment were used for traffic control and transportation of men and materials.

FIGURE 4

Two Ton Truck with HCA Lance and Melter

CONSTRUCTION

On June 7, 1982, the trials were started in the westbound passing lane at Richmond Rd. Up to 3 km of single lane would be closed down at a time allowing work to progress through three trial sections without having to adjust the traffic control.

At the beginning of each day's work, the water truck would thoroughly wet down the pavement in the closed off lane. The weather was good throughout the trials with average daily temperatures of 20^{o}C drying the pavement surface quickly. Even so, the cracks would remain damp throughout the work period.

Routing

In the sections requiring routing, the two routers easily kept ahead of the sealing operation; sometimes even working two sections ahead of

the sealing work. One router was set up to cut 13 mm^2 and the other 19 mm^2, then each router would work separate sections. This system reduced the down time required to change cutters to cut different widths.

Sawing

The wet diamond sawing with the "Runway Crack Cutter" was found to be extremely slow with only 67 metres of crack cut in the first five and one quarter hours of work as compared to 300-400 metres per hr for a router. Because of the poor production rate, a decision was made to only saw one lane of each designated section and to rout the other lane. A separate traffic control zone was set up to diamond saw the other designated sections ahead of time, so as not to further restrict production.

When the operator of the diamond saw tried forcing the machine to achieve better production, the blade would rise up and thus the cut depth was diminished.

The cutting slurry produced by the diamond saw would obscure the crack, making it difficult for the operator to follow. Painting the cracks yellow with a spray bomb ahead of cutting greatly improved visibility for the operator.

The cut produced by the Runway Crack Cutter was very clean with smooth vertical sides and a flat bottom. This is in contrast to router cuts with ragged sides and bottom with loosened aggregates.

Flushing

Water flushing of the designated cuts cleaned out the debris very well, removing the fine slurry on the cut faces of the sawn and routed cracks. A garden hose and nozzle from the pump on the water truck was used for this operation.

HCA

It was intended that the sealant would be installed immediately behind the HCA treatment which required the lance to be operated behind the melting kettle. This was tried for a short period of time but a

concern for safety dictated a procedural change. With three men working in close proximity behind the kettle, one with the HCA lance and one with the wand from the melter discharging hot sealant and the third with the band forming tool, the chance for an accident was considered too great. A decision was made to have the HCA lance w[illegible] alongside and ahead of the truck hauling the melter and the sealing operation to work alongside and behind the melter. As the work progressed down the road, the driver of the truck had to be very alert so as to co-ordinate his forward travel to meet the need of both operations.

The HCA lance performed well, drying out, heating and etching the prepared cracks at a slow walk. The lance operator had to take care to blow the routing debris back wide enough so that it would not get caught by the band forming tool used for shaping the sealant. This became a problem if the blast from the lance was concentrated in the routed groove only, without fanning the blast around. The only time trouble was encountered drying the groove occurred on a grade where free water was running back from water flushing operations ahead. After treatment with HCA, all the cut cracks regardless of preparation method, had a very similar appearance with the matrix etched out in the groove. The operators of the HCA lance were rotated to other duties about every 15-20 minutes because their feet got uncomfortably hot. The five 45 kg propane bottles supplying the lance lasted for the full ten working days of the trials with propane left over. It was later found that an average of one bottle per 8 hr. day was consumed by the lance. See Appendix II "1982 Ottawa District Routing & Sealing Experience".

Sealing

The hose and wand on the Crafco kettle became plugged several times during the trials and this usually was a result of trying to melt fresh material "on the go". In one case, subsequent testing found that the plastic wrapping on the cakes of one brand of sealant had too high a melt point and that this was likely the cause of the plugging. To avoid the reoccurrence of this problem, enough material would be melted early in the morning to last till lunch break and then fresh material melted during lunch for the afternoons needs.

Several band forming tools were tried; some plain steel and others with different grades and thicknesses of rubber. The plain steel devices were found least desirable because they would catch on the pavement surface texture and not push along smoothly. The tools with rubber band formers were easier to push and formed the bead over the prepared crack better. It was evident that the forming tools with a low push point were the easiest to work. The best band forming tool was a floor squeegee manufactured by the Fuller Brush Company, bent to form a "U" with a crescent of rubber cut out at the back to form the bead. This squeegee is different from other floor squeegees in that the rubber is moulded symmetrically around a steel reinforcement rather than being clamped onto a steel frame. The handle assembly bolts on through the centre so that when one side is worn out, the squeegee can be turned over for double life. It was found that the crescent cut out in the back of the squeegee would require recutting a little each day with a pocket knife to compensate for wear. The crescent could be kept clear of sealant by inverting the squeegee at the end of each use so that the sealant drained away from it. See Appendix III, "Modification of Fuller Brush Squeegee".

Observations

The successful forming of the bead over the prepared crack is influenced by the viscosity of the sealant being placed. It was found with all three materials, that at the higher end of the recommended application temperature range, the bead would slump back out after being formed. This problem could be reduced by allowing the sealant in the rout to cool slightly before forming with the squeegee. It is also important that the bead be centered over the prepared crack. If the bead is not formed over the groove, the material upon cooling will subside in the groove and the bead will be left standing proud beside it. This is likely to lead to early failure of the seal in winter because there is not enough material to stretch at the edge of the groove. When the desired cross-section was attained, inspection the next day after installation usually revealed the bead had flattened out except in the sections where the cracks had not been opened up by routing or sawing. The bond of the sealants to the pavement surface was inferior where the pavement was not etched by the HCA. This was determined by rolling back the edge of the sealant and attempting to peel it off.

The overall bond of the three sealants to the pavement surface was evaluated at the end of the trials resulting in the following ranking in decending order:

Hi-Spec,
Supergook,
Cariphalte ELT.

The quantity of sealants purchased for the trials proved to be insufficient to complete all the sections. This was due to the cracks being deeper than anticipated and as much as 100 mm deep for the half metre next to the edges of pavement. The balance of the trials was subsequently sealed at a later date using Hydrotech Sealz 6160 which the District was using for its regular maintenance crack sealing work. This will allow for a close comparison of performance between a standard material formulated to meet the A.S.T.M. D-1190 Specification and the "premium" products selected for the trials. Apendix I contains a summary of installations plus individual installation notes for each section.

The pavement surface throughout the trial sections was depressed 5 to 10 mm over about 80 mm each side of the pavement cracks. The sealing of these cracks with the shaped overband seal improved the riding quality of the pavement.

December 1982 Evaluation of Trial Sections

A review of the trial sections on December 7th and 8th, 1982 revealed that the method of crack preparation had not as yet influenced performance. There was no splitting with any of the six methods of crack preparation employing either the Meadows Hi-Spec or the Shell Cariphalte ELT materials. There was some splitting occurring in four of the trials sealed with the Bemac Supergook.

The Hydrotech 6160, which was installed in the balance of the trial sections not sealed with the test materials, is not performing well. The 6160 has a "wet" appearance and has flattened out and spread on the pavement surface, completely eliminating any bead of material. Approximately 30% of the Hydrotech 6160 seals are exhibiting splitting at the edges of the routed cracks.

The major factor influencing performance to date, appears to be the sealing material employed, regardless of preparation method.

The splitting of the seals in the first four Supergook sections may be partially attributable to an insufficient bead of material formed over the crack or cut groove. In the first three sections, in the passing lane, various strike off devices were employed to form the seal which did not provide the desired cross-section of sealant. The bead of material left over the crack in the passing lane was insufficient and appears to be the reason for the premature splitting. The driving lane in sections 1 & 2 which had a much better bead formed with the Fuller squeegee exhibits less splitting of the seals.

Snow plows have scuffed and cut off some of the sealant on the surface, primarily in the Cariphalte sections. Sealant has not been pulled out of the sawn or routed cracks in any section. Longitudinal seals were noted to be most prone to plow damage. Individual appraisal sheets for each section are contained in Appendix IV.

Future Work

The eighteen trials will continue to be monitored. A second interim report on the performance of the seals will be prepared at the end of 1983. A final report on the project is anticipated for 1984.

APPENDIX I - 1

Summary of Installations

SECT. NO.	LANE	METHOD/MATERIAL
1	Both Passing and Driving Lanes W.B.	No cut/HCA/ Seal Supergook Batch No. 1
2	W.B. Passing Lane	Wet Saw/Flush/HCA/ Seal Supergook Batch No. 1 West 1/3 Seal Supergook Batch No. 2 East 2/3
	W.B. Driving Lane	13 mm^2 Rout/HCA/ Seal Supergook Batch No. 1
3	W.B. Passing Lane	13 mm^2 Rout/HCA/ Seal Supergook Batch No. 2
	W.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
4	W.B. Passing Lane	19 mm^2 Rout/HCA/ Seal Supergook Batch No. 2
	W.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
5	W.B. Passing Lane	13 mm^2 Rout/Water Jet/HCA/ Seal Supergook Batch No. 2
	W.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
6	W.B. Passing Lane	19 mm^2 Rout/Water Jet/HCA Seal Supergook Batch No. 1
	W.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
7	Both Passing and Driving Lanes W.B.	HCA/Seal Hi-Spec
8	W.B. Passing Lane	Wet Saw/Flush/HCA/ Seal Hi-Spec
	W.B. Driving Lane	Rout 13 mm^2/HCA/ Seal Hi-Spec
9	W.B. Passing and Driving Lanes	Rout 13 mm^2/HCA/ Seal Hi-Spec
10	W.B. Both Lanes of Ramp to Eagleson Rd.	Rout 19 mm^2/HCA/ Seal Hi-Spec

SECT. NO.	LANE	METHOD/MATERIAL
11	E.B. Passing and Driving Lanes	Rout 13 mm^2/Water Jet/HCA/ Seal Hi-Spec
12	E.B. Passing Lane	Rout 19 mm^2/Water Jet/HCA/ Seal Hi-Spec
	E.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
13	E.B. Passing Lane	HCA/Seal Cariphalte
	E.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
14	E.B. Passing Lane	Wet Saw/Flush/HCA/ Seal Cariphalte
	E.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
15	E.B. Passing Lane	13 mm^2 Rout/HCA/ Seal Cariphalte
	E.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
16	E.B. Passing Lane	19 mm^2 Rout/HCA Seal Cariphalte
	E.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
17	E.B. Passing Lane	13 mm^2 Rout/Water Jet/HCA/ Seal Cariphalte
	E.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160
18	E.B. Passing Lane	19 mm^2 Rout/Water Jet/HCA/ Seal Cariphalte
	E.B. Driving Lane	Rout/HCA/ Seal Hydrotech 6160

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
1	HCA Only	Supergook

DATE/TIME	NOTES
82 06 07	Westbound passing lane - a.m. 10°C, p.m. 20°C
9:30	- water truck wet down pavement. - used HCA lance to blow out and heat cracks. - Supergook batch No. 1 used between 204 and 210°C. - tried out several variations of "U" shaped squeegees, made in the MTC machine shop, with a crescent cut out of the rubber to form a bead of material over the crack. These did not work very well due to the geometrics of the handle mounting. Also tried a "U" shaped steel strike off with a crescent cut out to form a bead - this was very hard to push since it grabbed the pavement.
10:00	- finished passing lane and moved on to section 2.
82 06 09	Westbound driving lane and ramps - a.m. 12°C, p.m. 28°C
11:00	- started sealing behind HCA with Supergook batch No. 2. - using Fuller squeegee. - a portion between Richmond Rd. and Acres Rd. was sealed using a pouring pot and the Kardey band forming tool. This device gives a flat strike off and the material then subsides into the crack leaving a concave form rather than the desired convex.
11:45	- stopped - added more material to kettle to melt down over lunch.
13:10	- material at 160°C - plugged up hose and wand. - changed hoses and cleaned wand.
14:00	- material at 204°C - started sealing again - slow flow??
14:25	- stopped sealing and circulated material through hose and wand to warm it up.
14:45	- material froze up in hose - 204°C in kettle - pulled off road for day.
82 06 18	Westbound driving lane - a.m. 15°C
9:35	- started sealing at Gore area Exit 131 with Supergook batch No. 1 at 190°C.
9:55	- finished sealing section.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
2	Wet Saw 13 mm^2, Water Flush & HCA Passing Lane Rout 13 mm^2 & HCA Driving Lane	Supergook

DATE/TIME	NOTES
82 06 07	Westbound passing lane - a.m. 10°C, p.m. 20°C
10:15	- started wet sawing cracks. - this operation is very slow - only cut seven transverse cracks by noon. - the depth of cut is hard to control - if an attempt is made to cut faster, the saw rises and the depth of cut is reduced from that desired. - it was found necessary to paint the cracks with a spray bomb of yellow paint so that the operator could see them through the cutting slurry produced by the saw. - the cut cracks were flushed clean with water and then dried and heated with HCA. - sealing with Supergook batch No. 1 using a "U" shaped squeegee made by Ottawa District - not forming enough of a bead so cut out more of a crescent at back. Works fair.
14:00	- terminated sealing operation - waiting too long on saw. - the sealant was installed between 193 and 210°C.
15:30	- stopped sawing for day with only 67 m cut. Worked straight through lunch hour.
82 06 08	Westbound passing lane continued - a.m. 12°C, p.m. 22°C
9:05	- started sawing cracks.
11:35	- started sealing cracks using Fuller squeegee. - Supergook batch No. 2 at 210°C.
12:00	- sealing operation caught up to saw and then skipped ahead into section 3. - material temperature up to 224°C.
12:55	- finished sawing passing lane.
82 06 09	Westbound driving lane - a.m. 12°C, p.m. 28°C
1:00	- started routing 13 mm^2.
3:00	- finished routing section.
82 06 18	Westbound driving lane
9:55	- started sealing with Supergook batch No. 1 and Fuller squeegee.
10:50	- material at 188°C.
11:15	- finished section.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
3	Rout 13 mm^2, and HCA	Supergook

DATE/TIME	NOTES
82 06 08	Westbound passing lane - a.m. 12°C, p.m. 22°C
9:05	Started routing.
10:20	Finished routing.
12:00	Started sealing with Supergood batch No. 2 using Fuller squeegee. Material at 224°C.
	Not getting enough of a bead of material over routed groove so cut out a larger crescent in the back of the Fuller floor squeegee bent in a U form. Now getting a very good cross-section of sealant. This squeegee works better than anything tried to date; it is very easy to push and can be used with one hand only.
	There is still some evidence of moisture as the sealant is bubbling. The cracks are very deep and the HCA is not likely drying as deep as the sealant will penetrate.
12:40	Finished sealing passing lane.
	Note: The driving lane of this section was routed 19 mm^2 and filled with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
4	Rout 19 mm^2 and HCA	Supergook

DATE/TIME	NOTES
82 06 08	Westbound passing lane - a.m. 12°C, p.m. 22°C
	Had problems setting up one of the routers to cut the 19 mm due to wear of the spacing washers. Had to pack in one extra washer than normally used to get the desired width of cut.
12:15	Started routing.
13:40	Started sealing with Supergook batch No. 2 at 207°C using Fuller squeegee.
	The material is slow flowing out of wand.
15:10	Stopped routing for day.
15:30	Material froze up in hose and wand.
	Took kettle back to Patrol Yard, removed hose and pumped material out onto dusted pavement. We were concerned that the material might be gelling due to being overheated earlier in the day in Section No. 2 and 3. The material that was pumped out looked O.K. and was free of any lumps.
82 06 09	Westbound passing lane - a.m. 12°C, p.m. 28°C
9:15	Carried on routing.
9:20	Started sealing with Supergook batch No. 2 at 190°C.
9:50	Finished routing passing lane.
10:00	Finished sealing passing lane - material at 205°C.
	Note: The westbound driving lane was routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.
	Note: A sample of the plastic covering on the cakes of material was checked for melt point in the Downsview laboratory and found to still be a gell at 193°C. It is highly likely a gob of this material restricted the flow of material in the hose and wand resulting in the slow flow and eventual plugging.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
5	Rout 13 mm^2, Water Flush & HCA	Supergook

DATE/TIME	NOTES
82 06 14	Westbound passing lane - a.m. 12°C, p.m. 21°C
8:20	Started routing.
8:50	Started flushing routed cracks with water.
8:55	Started sealing with Supergook batch No. 2 at 186°C using Fuller squeegee.
	Working in very wet conditions. - In an effort to dry out the routs, the HCA is burning the routs out wider. Even so, there is still moisture present down deeper in the cracks as evidenced by a lot of bubbles forming in the freshly placed sealant.
9:15-9:30	Break.
	The water flushing is cleaning the routs well. The routing has missed the actual crack in several locations and although set to cut 13 mm, they are actually cutting around 16 mm.
	On the upgrade, water is running back down to the HCA - hard to dry up.
10:20	Finished routing.
11:15	Ran out of material with about 30 m of crack left to seal.
11:20	Started charging kettle with Supergook batch No. 1 to melt down over lunch.
13:10	Started sealing.
13:15	Finished sealing passing lane.
	Note: Driving lane routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
6	Rout 19 mm^2, Water Flush and HCA	Supergook

DATE/TIME	NOTES
82 06 14	Westbound passing lane - a.m. 12°C, p.m. 21°C
10:45	Started routing with one router only. Water flushing routed grooves.
12:05	Finished routing.
13:15	Started sealing with Supergook batch No. 1 at 182°C. Not as much bubbling of sealant as compared to Section No. 5.
14:20	Finished sealing with material now at 204°C.
	Some traffic came in behind the zone control cones at the west end of the section, before the material had cooled down, and damaged the seals.
	Note: Driving lane routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
7	HCA Only	Hi-Spec

DATE/TIME	NOTES
82 06 10	Both westbound lanes
9:30	Started sealing passing lane with material at 190°C. Material strikes off nicely and forms a good bead.
10:20	Finished sealing passing lane.
14:50	Set up zone control to work in driving lane.
14:55	Started sealing driving lane with material at 185°C.
15:25	Finished sealing driving lane and moved on into Section 8.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
8	Wet Saw 13 mm^2, Water Flush and HCA - Passing Lane Rout 13 mm^2, and HCA - Driving Lane	Hi-Spec

DATE/TIME	NOTES
82 06 08	Westbound passing lane - a.m. 12°C, p.m. 22°C
	Started wet sawing.
	Stopped wet sawing.
82 06 09	Westbound passing lane - a.m. 12°C, p.m. 28°C
	Started wet sawing.
	Finished wet sawing.
82 06 10	Westbound passing lane and driving lane
10:20	Started sealing with material at 195°C.
	There are wide and also multiple centreline cracks in this section which are using a lot of material.
10:35	Finished sealing passing lane.
15:00	Started routing driving and ramp lanes 13 mm^2.
15:25	Started sealing with material at 190°C.
15:45	Ran out of material.
15:50	Routing stopped for day.
82 06 11	Westbound driving lane - a.m. 12°C, p.m. 20°C
8:20	Started routing.
8:30	Finished routing and started sealing with material at 190°C.
9:15	Finished sealing section and moved on into Section 9.

TRIAL NO.	PREPARATION METHOD	MATERIAL
9	Rout 13 mm^2 and HCA	Hi-Spec

DATE/TIME	NOTES
82 06 10	Westbound passing lane
9:10	Started routing.
10:50	Started sealing with material at 200°C.
11:00	Finished routing.
11:05	Stopped sealing and added cakes of material to kettle.
13:00	Material only up to 130°C.
13:50	Material at 173°C.
13:55	Started sealing.
14:00	Material at wand discharge 162°C and 178°C in kettle.
	Very wide centreline cracks up to 50 mm in many locations - using material up fast.
14:30	Finished sealing.
82 06 11	Westbound driving lane - a.m. 12°C, p.m. 20°C
8:55	Start routing.
9:15	Started sealing.
9:25	Stopped sealing and added cakes of material to kettle. Routers stopped for break.
9:40	Routers started again.
10:00	Hose and wand plugged up - changed hose and burned out wand.
10:10	Finished routing.
11:20	Started sealing with material at 185°C.
12:00	Finished sealing.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
10	Rout 19 mm^2 and HCA	Hi-Spec

DATE/TIME	NOTES
82 06 11	Ramp 417 westbound to Eagleson Rd. - a.m. 12°C, p.m. 20°C
12:05	Started routing with one router only.
13:15	Started sealing with material at 195°C.
13:45	Router moved to other side of ramp.
14:35	Ran out of material - all operations stopped.
82 06 17	Eagleson Rd. Ramp - a.m. 12°C, p.m. 21°C
10:00	Started routing with one router only.
10:20	Stopped routing.
10:40	Started sealing with material at 206°C. Getting some excessive flow of material.
	This ramp is badly distorted and the cracks are deep and the pavement depressed quite a bit at the cracks. There is alligator cracking along the centreline and a few areas have been patched with cold mix.
11:10	Started routing again.
11:25	Finished routing.
11:30	Stopped sealing and moved traffic over to other lane.
11:45	Started sealing again.
11:50	Finished sealing.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
11	Rout 13 mm^2, Water Flush and HCA	Hi-Spec

DATE/TIME	NOTES
82 06 16	Eastbound passing lane - a.m. 12°C, p.m. 18°C
13:45	Started routing with only one router and water flushing.
14:30	Finished routing.
82 06 17	Both passing and driving lanes - a.m. 12°C, p.m. 21°C
9:30	Started sealing with material at 183°C.
	The pavement is surface dry with moisture still in the routs.
	The material is showing some bubbling, probably due to moisture down in crack below the rout that was not dried up by the HCA.
9:50	Finished sealing passing lane and moved on into Section 12.
11:00	Started routing driving lane with one router only.
12:15	Finished routing.
13:35	Started sealing with material at 162°C.
13:50	Material at 177°C.
	A lot of bubbling of sealant occurring in spite of a good treatment of HCA.
14:05	Material at 193°C.
14:40	Finished sealing whole section.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
12	Rout 19 mm^2, Water Flush and HCA	Hi-Spec

DATE/TIME	NOTES
82 06 16	Eastbound passing lane - a.m. 12°C, p.m. 18°C
14:50	Started routing and water flushing.
15:50	Finished routing.
82 06 17	Eastbound passing lane
9:50	Started sealing with material at 194°C.
	The pavement is surface dry with moisture still showing in the routed grooves.
	There is some bubbling of the sealant.
	The bead of material over the rout is slumping out in some areas.
10:25	Finished sealing.
	Note: The driving lane was routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
13	HCA Only	Cariphalte ELT

DATE/TIME	NOTES
82 06 15	Eastbound passing lane - a.m. 12°C, p.m. 18°C
8:25	Start sealing with material at 178°C. Started off using a U shaped steel strike off device with a crescent shaped back to form a heavy band of material. This device, supplied by Shell, proved to be hard to push along the pavement and used considerably more material than the Fuller squeegee currently being used. Switched back to using the Fuller squeegee. In the first half of this section, the pavement surface was still quite wet and the truck and melter wheels would track moisture across the transverse cracks dried by the HCA. This will likely inhibit a bond in the wheel paths on the pavement surface.
10:00	Material running 155-160°C at wand discharge.
10:20	Compressor overheated and shut down.
10:45	Started back to work.
10:50	Stopped for break.
11:00	Started back to work.
11:05	Finished sealing passing lane and moved on into Section 14.

Note: Driving lane was routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
14	Wet Saw 13 mm^2, Water Flush & HCA Passing Lane Only	Cariphalte ELT

DATE/TIME	NOTES
82 06 14	Eastbound passing lane - a.m. 12°C, p.m. 21°C
15:00	Started sawing and flushing.
15:25	Stopped sawing.
82 04 15	Eastbound passing lane - a.m. 12°C, p.m. 18°C
8:20	Started sawing.
11:05	Started sealing with material at 170°C.
	A fair amount of bubbling of the sealant occurring even though the HCA is etching out the cut grooves pretty good.
11:35	Caught up to sawing operation and skipped by it into Section No. 15.
12:30	Finished sawing passing lane.
13:45	Started sealing with material at 180°C.
13:55	Finished sealing passing lane.
	Note: The driving lane was routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
15	Rout 13 mm^2 and HCA	Cariphalte ELT

DATE/TIME	NOTES
82 06 14	Eastbound passing lane - a.m. 12°C, p.m. 21°C
15:00	Started routing with one router only.
15:25	Stopped routing.
82 06 15	Eastbound passing lane - a.m. 12°C, p.m. 18°C
8:20	Started routing with one router only.
10:45	Finished routing.
11:35	Started sealing with material at 175°C.
11:50	Stopped sealing, added more material to kettle.
13:55	Started sealing with material at 195°C.
	At railway overpass - material has excessive flow and it is hard to form a bead of material over the routed groove.
	Near the end of section - the material has cooled to 165°C and there is still a problem with excessive flow.
15:30	Finished sealing passing lane.

Note: The driving lane was routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
16	Rout 19 mm^2 and HCA	Cariphalte ELT

DATE/TIME	NOTES
82 06 14	Eastbound passing lane - a.m. 12°C, p.m. 21°C
15:00	Started routing with one router only.
15:25	Stopped routing.
82 06 15	Eastbound passing lane - a.m. 12°C, p.m. 18°C
8:20	Started routing with one router only.
10:20	Finished routing.
15:35	Started sealing with material at 160°C.
15:40	Shut down for the day.
82 06 16	Eastbound passing lane - a.m. 12°C, p.m. 18°C
9:10	Started sealing with material at 160°C. There is some bubbling of the sealant. The material is forming a bead O.K.,with only a little flow of the material with cross-fall. There are not too many cracks in the passing lane of this section.
9:40	Finished sealing.
	Note: The driving lane was routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
17	Rout 13 mm^2, Water Flush & HCA	Cariphalte ELT

DATE/TIME	NOTES
82 06 16	Eastbound passing lane - a.m. 12°C, p.m. 18°C
9:25	Started routing with one router only and flushing cracks.
10:15	Started sealing cracks with material at 160°C. Working in wet pavement and yet there is very little bubbling of material in groove.
10:45	Finished routing.
11:20	Finished sealing passing lane.
	Note: The driving lane was routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

INSTALLATION NOTES

TRIAL NO.	PREPARATION METHOD	MATERIAL
18	Rout 19 mm^2, Water Flush & HCA	Cariphalte ELT

DATE/TIME	NOTES
82 06 16	Eastbound passing lane - a.m. 12°C, p.m. 18°C
9:25	Started routing with one router only.
10:50	Stopped routing and started water flushing routs.
11:20	Started sealing with material at 185°C. Pavement is wet in the vicinity of the routs.
11:35	Stopped sealing due to catching up to water flushing operation. Added more material to kettle to melt down during lunch break.
13:00	Started sealing with material at 164°C.
13:40	Finished sealing all the cracks that were routed. Did not rout whole section for fear we would run out of sealant.
14:10	Started routing and water flushing.
14:25	Stopped routing and started sealing.
14:30	Hose and wand plugged up at Acres Rd. underpass - out of material.
82 06 18	Eastbound passing lane.
11:25	Finished filling section with Supergook batch No. 1 at 188°C.
	Note: Driving lane routed 19 mm^2 and sealed with Hydrotech 6160 at a later date.

1982 Ottawa District Routing & Sealing Experience *

Upon completion of the trial sections, the Ottawa maintenance crew continued to use the HCA Lance in their routing and sealing programme for the balance of the season.

The crew was comprised of ten men:

LABOUR

2 men on traffic control,
2 men routing cracks,
1 man operating the HCA Lance,
1 man driving 2 tonne truck with compressor and kettle,
1 man on applicator hose and wand placing sealant,
1 man forming sealant with a squeegee,
1 man dusting seals with Portland cement,
1 foreman monitoring and controlling heat of kettle and measuring production.

The men dusting seals and operating the lance rotated duties every 15-20 min.

MATERIALS

Material usage was as follows:

2-45 kg bottles of propane per day (HCA-1 & Melter-1),
0.5 kg of sealant per metre,
1-40 kg bag of Portland cement per day for dusting seals.

PRODUCTION

Production of 1500 - 1800 lineal meters per eight hour day was typical on two lane highways.

On four lane highways with a higher frequency of cracks, production was increased to 2500 - 2800 metres per day. At this higher production rate the Crafco Kettle limited production. The inability to melt product "on the go" would create a shortfall of material in late afternoon.

Ottawa District is modifying the kettle by placing a screen over the pump inlet in an attempt to eliminate the problem of lumps of material plugging the system when additional material is added.

OBSERVATIONS

The HCA lance was considered a significant asset to the crew, since its use eliminated down time for moisture in the mornings and after a rainfall, the crew would be back in production within a half hour.

Wrapping the pump and the discharge hose with inexpensive pipe insulation ($15) allowed work to proceed into the cool Autumn weather.

In previous years, the foreman and a lead hand remained with the routing and sealing equipment and travelled from one patrol to the next, obtaining the required labour force from each patrol they worked in. In 1982, a whole crew was maintained which travelled throughout the district, resulting in greatly improved workmanship and productivity. The improvement is considered the result of each man knowing his specific job better through prolonged experience.

The HCA lance was also successfully employed by the district forces to erase zone paint on traffic moves.

* Ref. Internal Reports by J. Armstrong, Maintenance Supervisor
T. J. Sullivan, Crew Foreman

APPENDIX III

Modification of Fuller Brush Squeegee

Original Squeegee

Squeegee Bent and a Crescent Cut Out

Finished Strike Off

SECTION # 1 PRODUCT Supergook

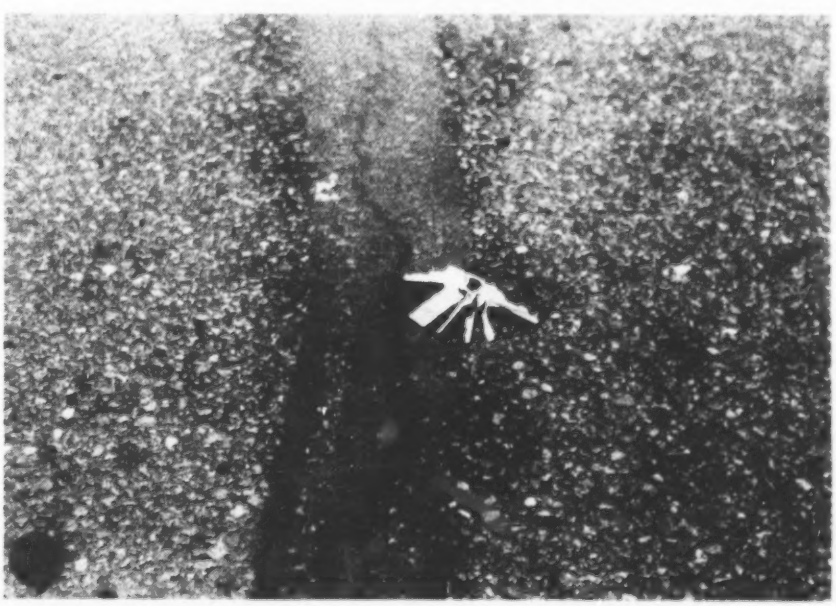
DATE 82 12 07 WEATHER Overcast 0°C

NOTES:

There is more splitting of the sealant in the passing lane than in the driving lane due to a good bead not being formed originally in the passing lane. We were experimenting with various strike off devices in the passing lane for the first three test sections and not all of them provided an adequate bead of material.

The sealant is firm and flush to the pavement.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant			X			
Bond Failure	X					
Cohesive Failure			X			
Missing Sealant	X					
New Pavement Cracks	X					



SECTION # 2 PRODUCT Supergook

DATE 82 12 07 WEATHER Overcast 0°C

NOTES:

All the splitting of the sealant is in the passing lane and the edge of the saw cut - very little of a bead was formed in the passing lane.

The plows have cut off some of the sealant on the longitudinal centreline seals but have not pulled any sealant out of the groove.

The sealant is flush in the groove. There are two transverse cuts in the passing lane that never got sealed.

Space between nails - 260.0 mm

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant		X				
Bond Failure		X				
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks		X				

FIELD OBSERVATIONS

SECTION # 3 PRODUCT Supergook

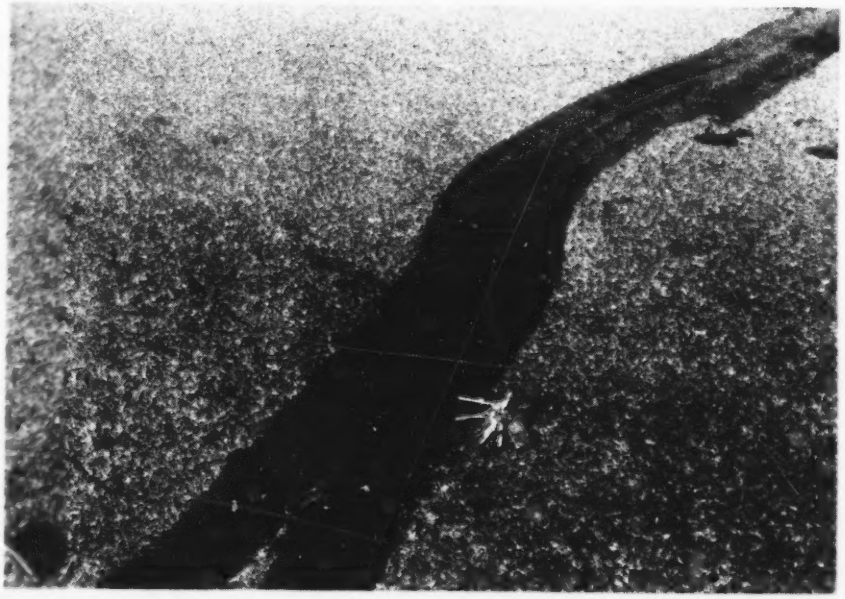
DATE 82 12 07 WEATHER Overcast 1°C

NOTES:

The sealant is flush to slightly proud of the pavement surface. The splitting is at the edge of the routed groove.

The Hydrotech 6160 in the driving lane is exhibiting a lot more splitting. The 6160 has a "wet" appearance as though it contains a solvent and it has flattened out and spread on the pavement surface.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant		X				
Bond Failure		X				
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks		X				



FIELD OBSERVATIONS

SECTION # 4 PRODUCT Supergook

DATE 82 12 07 WEATHER Overcast 3°C

NOTES:

The sealant is flush to slightly proud of the pavement surface. The splitting is at the edges of the routed crack. The Supergook has a very good bond to the pavement surface.

The Hydrotech 6160 in the driving lane has been flowing down grade and is splitting at the edges of the groove.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant		X				
Bond Failure		X				
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 5 PRODUCT Supergook

DATE 82 12 07 WEATHER Overcast 5°C

NOTES:

The Supergook in the passing lane is slightly proud of the pavement surface.

The Hydrotech 6160 in the driving lane is flat and cracking at the rout edges.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 6 PRODUCT Supergook

DATE 82 12 07 WEATHER Overcast 5°C

NOTES:

The Supergook is slightly proud of the pavement surface.

The Hydrotech 6160 in the driving lane is splitting at the edges of the rout.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 7 PRODUCT Hi-Spec

DATE 82 12 07 WEATHER Overcast 5°C

NOTES:

The sealant is slightly proud of the pavement surface and is slightly softer than the Supergook. The sealant has an excellent bond to the pavement surface.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 8 PRODUCT Hi-Spec

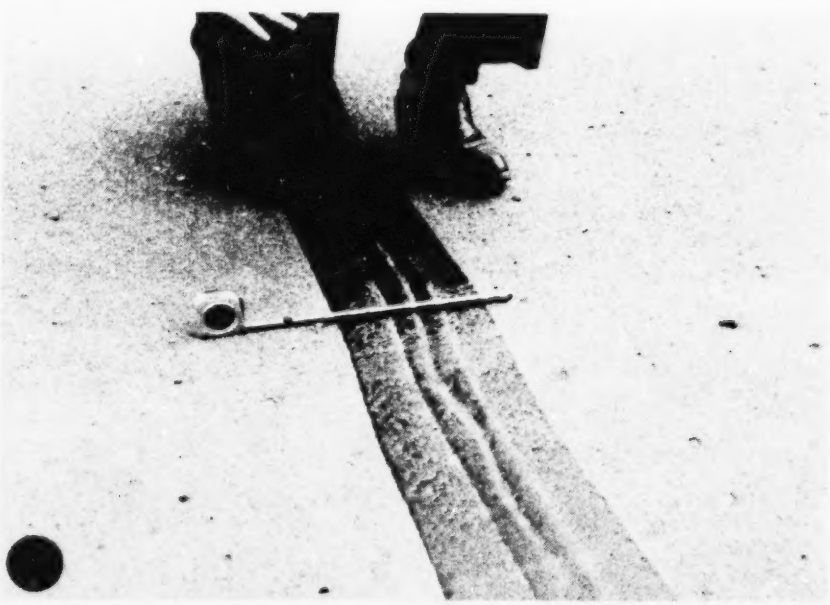
DATE 82 12 07 WEATHER Overcast 5°C

NOTES:

The sealant is slightly proud of the pavement surface.

Space between nails - 265.0 mm

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					



FIELD OBSERVATIONS

SECTION # 9 PRODUCT Hi-Spec

DATE 82 12 07 WEATHER Overcast 5°C

NOTES:

The sealant is slightly proud of the pavement surface.

The seals still look good where there were wide and multiple centreline cracks.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 10 PRODUCT Hi-Spec

DATE 82 12 07 WEATHER Overcast 3°C

NOTES:

The sealant is slightly proud of the pavement surface.

Even in the areas of distressed pavement the seals have so far maintained integrity.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

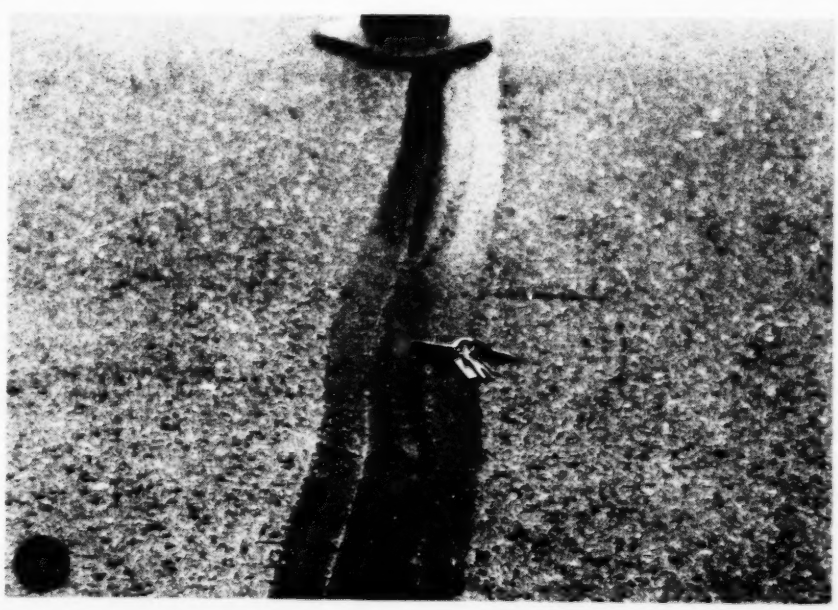
SECTION # 11 PRODUCT Hi-Spec

DATE 82 12 07 WEATHER Overcast 0°C

NOTES:

The sealant is slightly proud of the pavement surface.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					



FIELD OBSERVATIONS

SECTION # 12 PRODUCT Hi-Spec

DATE 82 12 07 WEATHER Overcast 0°C

NOTES:

The sealant is slightly proud of the pavement surface.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 13 PRODUCT Cariphalte ELT

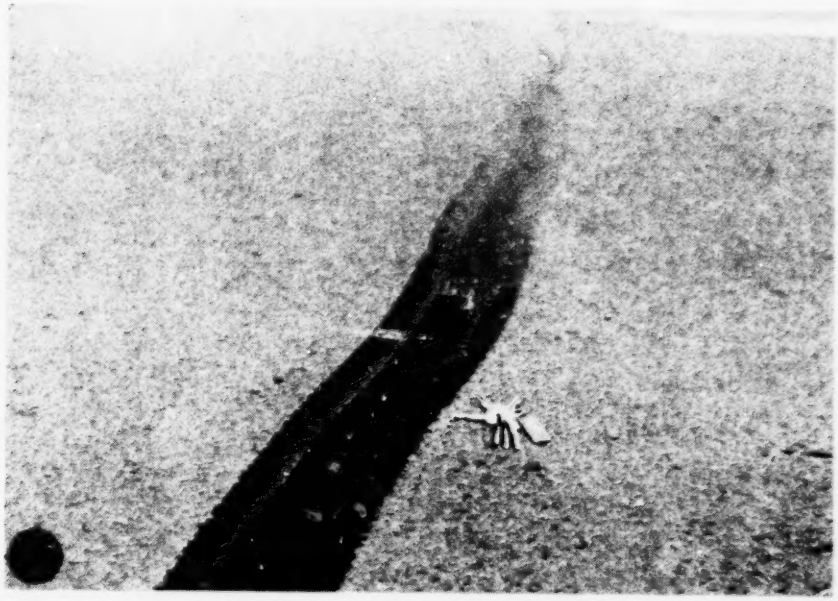
DATE 82 12 07 WEATHER Overcast 0°C

NOTES:

The sealant is slightly proud of the pavement surface and has been subjected to some minor scuffing by snow plows.

The Hydrotech 6160 in the driving lane has flattened out and is splitting at the edges of the rout.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					



FIELD OBSERVATIONS

SECTION #14 PRODUCT Cariphalte ELT

DATE 82 12 08 WEATHER Clear -5°C

NOTES:

The sealant is slightly proud of the pavement and the sealant has a crazed surface.

There is some minor plow damage of seals. The Hydrotech 6160 in the driving lane is splitting at the edges of the rout.

One of the two nails in this section has been plowed out.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 15 PRODUCT Cariphalte ELT

DATE 82 12 08 WEATHER Clear -6°C

NOTES:

The sealant is slightly proud of the pavement surface and has been subjected to some plow damage on the longitudinal centreline seals.

The Hydrotech 6160 in the driving lane is flattened out and splitting at the edges of the rout.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 16 PRODUCT Cariphalte ELT

DATE 82 12 08 WEATHER Clear -5°C

NOTES:

The seals are slightly proud of the pavement surface with some minor plow scuffing evident. The sealant is surface crazed.

The Hydrotech 6160 in the driving lane has flattened out and is splitting at the edges of the rout.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 17 PRODUCT Cariphalte ELT

DATE 82 12 08 WEATHER Cloudy -5°C

NOTES:

Sealant is slightly proud of pavement surface and is surface crazed.

There is moderate plow damage of longitudinal centreline seals.

The Hydrotech 6160 in the driving lane is flattened out and splitting at the edges of the routed cracks.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X					

FIELD OBSERVATIONS

SECTION # 18 PRODUCT Cariphalte ELT

DATE 82 12 08 WEATHER Overcast -4°C

NOTES:

The sealant is slightly proud of the pavement surface and the sealant is surface crazed.

The Hydrotech 6160 in the driving lane is flattened out and aplitting at the rout edges.

	None	0 - 10%	10 - 20%	20 - 50%	50 - 80%	80 - 100%
Rating Value						
Splitting of Sealant	X					
Bond Failure	X					
Cohesive Failure	X					
Missing Sealant	X					
New Pavement Cracks	X